Completed Project (2013 - 2015)

Fiber Optic Sensing Systems for Launch Vehicles Project

Advanced Exploration Systems Program | Human Exploration And Operations Mission Directorate (HEOMD)

ABSTRACT

AES in partnership with HEOMD's Launch Services Program and ARMD, plans to develop Fiber Optic Sensing System (FOSS) hardware for use with Launch Vehicle Systems.

AES participation in this project was completed at the end of FY 2015 (September 30, 2015).

ANTICIPATED BENEFITS

To NASA funded missions:

See "Capabilities Provided" under "DETAILS FOR TECHNOLOGY."

To NASA unfunded & planned missions:

See "Capabilities Provided" under "DETAILS FOR TECHNOLOGY."

To other government agencies:

See "Capabilities Provided" under "DETAILS FOR TECHNOLOGY."

To the commercial space industry:

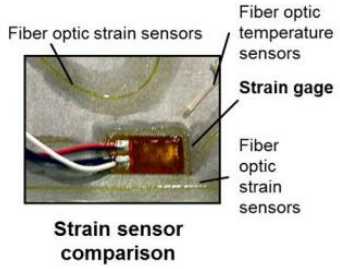
See "Capabilities Provided" under "DETAILS FOR TECHNOLOGY."

To the nation:

See "Capabilities Provided" under "DETAILS FOR TECHNOLOGY."

DETAILED DESCRIPTION

The objective of the Fiber Optic Sensing System (FOSS) activity is to demonstrate its value to space flight applications with the intent that it could be utilized by the Space Launch System program to realize performance improvements in that system. FOSS technology has the potential to dramatically improve structural and system efficiency by providing unprecedented



Strain Sensor Comparison

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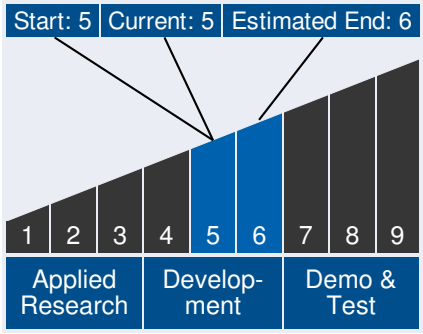
Technology Maturity



Management Team

Program Director:

- Jason Crusan

Program Executive:

- John Warren

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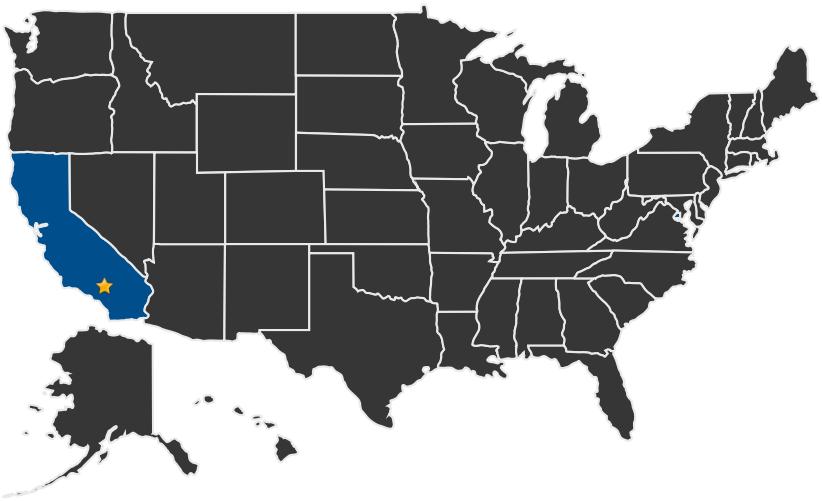
insight into the structural performance of a vehicle in an affordable manner.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Armstrong Flight Research Center

DETAILS FOR TECHNOLOGY 1

Technology Title

Fiber Optic Sensors Systems for LVs

Technology Description

This technology is categorized as a hardware system for manned spaceflight

Fiber Optic Sensing Systems (FOSS) have been typically employeed for terrestrial applications, but not for launch vehicles or spacecraft since the flight qualification step drives all solutions to the heritage design, which in this case is wires and strain gauges. The goal of this FOSS project is to raise the TRL of FOSS hardware to 6 by flying it so it can potentially be considered for infusion into SLS and other cryogenic launch vehicles in the future.

Management Team *(cont.)*

Project Manager:
- Jeffrey Bauer

Technology Areas

Primary Technology Area:
Nanotechnology (TA 10)
- Sensors, Electronics, and Devices (TA 10.4)
  - Sensors and Actuators (TA 10.4.1)
    - Embedded State Sensors (TA 10.4.1.1)

Secondary Technology Area:
Launch Propulsion Systems (TA 1)
- Ancillary Propulsion Systems (TA 1.4)
  - Health Management and Sensors (TA 1.4.5)

Fiber Optic Sensing Systems for Launch Vehicles Project

Capabilities Provided

When compared to traditional strain gauges and wiring baseline, this FOSS technology has the potential to improve launch vehicle sensor capabilities over the current baselind SOA by reducing sensor system mass to 1% or less, reducing lead wires from 3 per sensor to 1 per 2000 sensors, increasing parameters sensed from just strain to strain, temperature and shape, eliminating sensitivity to EMI, and reducing cost to 25% of the baseline.

Potential Applications

Potential applications for this technology are low cost, low mass launch vehicle sensors that provide real-time information of first mode structural bending of the launch vehicle, liquid level measurements of the launch vehicle's LO2 tanks during ground operations and flight, strain and temperature measurements of the launch vehicle thrust frame strut bending profile, and LO2 feed lines temperature measurements to get real-time insight into engine chill-down process.

Performance Metrics

Metric	Unit	Quantity
Sensor System Mass Reduction	%	99
Lead Wires Reduction	%	999
Cost Reduction	%	75